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2D. TRACK TEAM 2: INNOVATION PARADIGMS IN THE BIOECONOMY (II)

Value chain structures that define second generation bio-refineries in Europé

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1. Relevance
Literature on 2nd generation biomass refining highlights ways of reducing cost: 1. enzyme cost reduction; 2. reducing energy consumption for pretreatment; 3. securing feedstock provision, by increasing residue harvest rates, and enabling feedstock variability; 4. reduction of risk in infrastructure investments.

2. Research aim and questions
We hypothesize that development of 2nd generation bio-refineries is structured by: 1) the nature of the feedstock and resource availability; 2) the industrial actors (competences, existing capital stock/investments, incentives, objectives); and 3) coordination between various actors in the value chain. From this perspective, we seek to identify the barriers to greater diffusion of cellulosic biomass refining, and influence (failure) of current policies to address these barriers. Our claim is that these barriers could be addressed more effectively by considering economies of scope in the national and EU policies that intend to promote greater utilization of second generation bio-refining for fuel and other co-products.

3. Definitions
Second generation bio-refining is the process of breaking down the ligno-cellulosic structure of biomass to enable its enzymatic fermentation into end use products. A bio-refinery is a physical production plant where biomass is converted into end use products such as ethanol fuel, cellulose, and niche chemicals.

4. Theoretical Frameworks
To address this hypothesis and demonstrate our claim, we apply Global Value Chain (GVC) analysis. GVC analysis emerged in the early 1990s as a novel methodological tool for understanding the dynamics of economic globalization, international trade as well as particular industries such as automobile manufacturing (Sturgeon, et al. 2008). GVC is based on the analysis of discrete value chains where input supply, production, trade and consumption or disposal are explicitly and coherently linked. In GVC analysis, the concept of upgrading is used to identify the possibilities for producers to 'move up the value chain', either by shifting to more rewarding functional positions, or by making products that have more value-added invested in them or that provide higher returns. The upgrading process is examined through the lenses of how knowledge and information flow within value chains (Gereffi, et al., 2005; Bolwig, et al., 2010) and displays similarities with innovation system approaches. Recent literature points out that external actors such as governments, multilateral institutions, and non-governmental organizations (NGOs) can significantly influence GVC governance (Bolwig, et al., 2010; Ponte & Sturgeon, 2014), especially in emerging industries like those for renewables, thus creating multipolar chains (Ponte, 2014).

5. Empirical Materials
We conducted a survey of the policy landscapes, at both the EU and national levels. We also conducted interviews of firms that use 2nd generation refining technology within Denmark, Sweden, Norway, Spain and Italy- countries where pilot scale and production scale plants exist. The plants differ in terms of resources, technologies, policy landscape, and actors. Thus the case studies cover many different perspectives for how value chains form and function with respect to 2nd generation refining.

6. Description of the Methodologies

A survey was conducted of six different firms across Europe: Abengoa (Spain), Inbicon (Denmark), Örnsköldsvik (Sweden), Weyland (Norway), Borregaard (Norway), and Crescentino (Italy). The survey collected information on: the position of the studied value chain actors in the global market, in terms of technological advantage, presence in different markets; the feedstock supply; firm characteristics (size, ownership, recent developments, etc.); innovations (major achievements), their characteristics (disruptive or incremental) and the factors that drive them (e.g. public research and development funding); sources of finance for R&D and construction of larger plants; domestic market characteristics/ creating and the role of policy; and value added in different value chain segments (prices, costs, etc.).

7. Expected outcomes

Policies to promote 2nd generation bio-refining, and specifically, the production of cellulosic ethanol, tend to focus on technological innovation (e.g., research to reduce the price of enzymes), and targets/ mandates for ethanol production (renewable energy targets, tax incentives); i.e. they tend to focus on economies of scale. Yet the barriers to economies of scale are more than just technological. From a global value chain perspective, achieving economies of scale and scope, and thus reducing price requires the coordination of many actors. If policy, which generally focuses on subsidies and other incentives for technological development, were to consider economies of scope rather than just scale, the price of cellulosic ethanol would be reduced more efficiently, and it would better promote greater innovation within the bio-economy.

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